

WHAT IS CLAIMED IS:

1. A method of roasting coffee beans, comprising the steps of:  
supplying heat to the beans while the beans are disposed in an enclosed roasting chamber by burning a fuel in a burner outside of said chamber so that the products of combustion generated in said burner are isolated from said beans;  
venting an exhaust gas from said chamber including roasting byproducts;  
recycling at least a portion of the vented exhaust gas into the burner to thereby provide a mixture of fuel, air and exhaust gas;  
monitoring the composition of combustion products produced by said burner; and  
controlling the composition of said mixture responsive to said monitoring.
2. A method as claimed in claim 1, wherein said step of burning a fuel includes the step of supplying a fuel stream and an air stream to a burner and said recycling step is performed so as to incorporate at least some of the vented exhaust gas into the fuel stream.
3. A method as claimed in claim 2, wherein said exhaust gas includes said roasting byproducts in a substantially non-reactive gas.
4. A method as claimed in claim 1, wherein said recycling and controlling steps are performed so as to maintain said mixture at about 8% oxygen content.
5. A method of roasting coffee beans, comprising the steps of:  
supplying heat to the beans while the beans are disposed in an enclosed roasting chamber while directing a gas through said chamber so that an exhaust gas containing roasting byproducts including solid chaff and water vapor is discharged from said chamber;  
venting at least a portion of said exhaust gas through a recovery device so as to remove chaff from the vented exhaust gas; and  
condensing water vapor from the vented exhaust gas so that the condensed water wets at least some of the removed chaff.

6. A method as claimed in claim 5, wherein said step of venting said exhaust gas includes the step of directing the vented exhaust gas through a cyclone having cooled walls so that said cyclone removes chaff from the exhaust gases and condenses gas entrained water vapor.

7. A method of roasting coffee beans, comprising the steps of:

- a) providing coffee beans in a roasting chamber and directing a heated gas into said chamber and through said chamber so that the heated gas contacts the beans;
- b) preselecting a desired roasting bean temperature versus time profile;
- c) monitoring either or both of (1) the temperature of the beans; and (2) a set of parameters sufficient to determine the enthalpies and mass flow rates of the inlet gas and exhaust gas; and
- d) adjusting the condition of the inlet gas directed into the chamber responsive to the results of said monitoring step to minimize deviations between the determined and desired bean temperature versus time profiles.

8. A method as claimed in claim 7, wherein said monitoring step includes the step of monitoring the outlet temperature of gas leaving the chamber, whereby said outlet temperature will vary with the temperature of the beans.

9. A method as claimed in claim 7, wherein said monitoring step includes the step of monitoring the inlet and outlet pressures and temperatures and determining the amount of heat delivered to the beans as a function of time from said pressures and temperatures.

10. A method as claimed in claim 7, wherein said adjusting step includes the step of detecting when the amount of heat delivered to the beans equals the desired amount of heat necessary for roasting and halting roasting when such condition occurs.

11. A method as claimed in claim 7, wherein step of directing gas through said chamber includes the step of circulating at least a portion of the gas in a substantially closed

circulation system from said chamber through a condenser and a heater, and wherein said adjusting step includes the step of adjusting heat removal from the gas at said condenser.

12. A roaster for roasting beans, comprising:

- a) structure defining an enclosed roasting chamber having a top and a bottom, said structure including one or more bean transfer openings to permit the introduction of beans into said roasting chamber and withdrawal of beans from said roasting chamber;
- b) a gas inlet communicating with said roasting chamber adjacent the bottom of the chamber to direct gas through the beans and form a fluidized or suspended bed;
- c) a top screen disposed adjacent the top of said roasting chamber, said screen including a plurality of openings no larger than the size of the beans; and
- d) a gas outlet communicating with said roasting chamber above the top screen so that gas directed through the beans will pass through the top screen before passing through the gas outlet.

13. A roaster as claimed in claim 12, wherein said plurality of openings in said top screen are no larger than 4 mm.

14. A roaster as claimed in claim 12, wherein said roaster further includes a shutter mounted for movement over a range of positions in proximity to said top screen to cut off the flow of gas through a shifting sector of the top screen as the shutter moves across the screen, whereby beans engaged on the top screen at such sector will fall back into the bed.

15. A roaster as claimed in claim 14, wherein said shutter is mounted above said top screen.

16. A roaster as claimed in claim 14, wherein said top screen is in the form of a surface of revolution about a central axis, the roaster further comprising a shaft mounted in said chamber for rotation about said central axis, said shutter being mounted to said shaft so that said

shutter is movable across said top screen by rotating said shaft.

17. A roaster as claimed in claim 16, further comprising an agitator mounted to said shaft beneath said top screen for agitating beans in said chamber.

18. A roaster as claimed in claim 12, further comprising a bottom screen having a plurality of openings disposed adjacent the bottom of said chamber, said top and bottom screens bound a central region of the chamber for holding beans to be roasted, said gas inlet communicating with said chamber beneath said bottom screen, said screen having a bean outlet aperture coaxial with said shaft, said shaft having a hub mounted thereon below said shutter, said shaft being axially movable between an operating position in which said hub occludes said bean outlet aperture and a discharge position in which said hub does not occlude said bean outlet aperture.

19. A roaster as claimed in claim 12, further comprising a bottom screen having a plurality of openings disposed adjacent the bottom of said chamber, said top and bottom screens bound a central region of the chamber for holding beans to be roasted, said gas inlet communicating with said chamber beneath said bottom screen.

20. A roaster as claimed in claim 19, wherein said bottom screen has a sloping surface extending from a highest portion to a lowest portion and said bean transfer openings include a bean outlet aperture extending through said bottom screen at said lowest portion, the apparatus further comprising a closure for occluding said bean outlet aperture.

21. A roaster as claimed in claim 20, wherein said bottom screen is generally conical and has said lowest portions adjacent the tip of the cone, said bean outlet aperture being disposed at the tip of the cone.

22. A roaster as claimed in claim 20, wherein the open area of said screen per unit of

horizontal projected area of said bottom screen is greater in lowest portion of said screen than in the highest portion of said screen.

23. A pressure roasting system, comprising:

- a) a substantially closed circulation system including a roasting chamber for retaining a charge of beans to be roasted, a heater and at least one circulation blower connected to one another for circulating a gas under pressure in said circulation system through said roaster and heater;
- b) a pressure storage tank for holding gas at a pressure slightly above the maximum pressure used in the circulation system;
- c) a pressure release tank;
- d) a compressor connected between said pressure release tank and said pressure storage tank for transferring gas from said pressure release tank to said pressure storage tank to thereby maintain said pressure release tank at a pressure substantially lower than the pressure used in the circulation system;
- e) one or more selectively-operable pressure release valves for venting gas from said circulation system to said pressure release tank; and
- f) one or more selectively-operable gas charging valves for transferring gas from said pressure storage tank to said circulation system.

24. A roasting system as claimed in claim 23, further comprising one or more solids transfer locks each such lock having an interior space, a first transfer valve for selectively connecting the interior space to a location in said circulation system from which solids are to be transferred, a second transfer valve for selectively connecting the interior space to said pressure release tank, and a selectively operable lock venting valve for connecting said interior space to said pressure release tank.

25. A roasting system, comprising:

- a) a substantially closed circulation system including a roasting chamber for retaining a

charge of beans to be roasted, a heater and at least one circulation blower connected to one another for circulating a gas in said circulation system through said roaster and heater;

b) a chaff separator, said chaff separator including wall structure defining a separation chamber connected in said circulation system so that gas passing through said circulation system will pass through said separation chamber and means for physically separating chaff from gas passing in said separation chamber;

c) means for cooling gas as it passes through said chaff separation chamber to thereby condense water vapor from said gas in said separation chamber; and

d) a waste outlet communicating with said separation chamber for discharging wafer and chaff.

26. A system as claimed in claim 25, wherein said chaff separator is a cyclonic separator, said means for physically separating including means for directing gas passing through said separation chamber to flow in a cyclonic pattern.

27. A system as claimed in claim 26, wherein said means for cooling gas includes means for cooling the wall structure of said separation chamber.

28. A system as claimed in claim 26, further comprising a scraper mounted in said separation chamber for mechanically dislodging chaff from the wall structure of the separation chamber.

29. A system as claimed in claim 26, further comprising a discharge auger mounted in said separation chamber for forcing chaff and waste out of said separation chamber through said waste outlet.